PB87-166997

Many Roads and Other Worlds

(U.S.) Health Effects Research Lab.
Research Triangle Park, NC

Mar 87

U.S. Department of Commerce
National Technical Information Service
NTIS

PB87-166997

EPA/600/D-87/067
March 1987

MANY ROADS AND OTHER WORLDS

by

Gino Marco
Ciba Geigy Corporation

Robert Hollingworth
Purdue University

William F. Durham
Health Effects Research Laboratory
U.S. Environmental Protection Agency
Research Triangle Park, NC 27711

HEALTH EFFECTS RESEARCH LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

REPRODUCED BY
U.S. DEPARTMENT OF COMMERCE
NATIONAL TECHNICAL
INFORMATION SERVICE
SPRINGFIELD, VA 22161

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO. EPA/600/D-87/067	2.
3. RECIPIENT'S ACCESSION NO. PB87-186997/AS	
4. TITLE AND SUBTITLE MANY ROADS AND OTHER WORLDS	5. REPORT DATE March 1987
	6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) Gino Marco, Ciba Geigy Corp., Robert Hollingworth (Purdue University), William F.Durham, USEPA	8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS N/A	10. PROGRAM ELEMENT NO.
	11. CONTRACT/GRANT NO.
12. SPONSORING AGENCY NAME AND ADDRESS U.S. Environmental Protection Agency (USEPA) Office of Research and Development (ORD) Health Effects Research Laboratory (HERL) Research Triangle Park, North Carolina 27711	13. TYPE OF REPORT AND PERIOD COVERED
	14. SPONSORING AGENCY CODE EPA 600/11

15. SUPPLEMENTARY NOTES

16. ABSTRACT

This manuscript is the final chapter in the Proceedings of the American Chemical Society Symposium Silent Spring Revisited. The paper provides a summary of the preceding chapters of the symposium book which represent views of scientists from a variety of disciplines regarding changes in pesticide hazards since Silent Spring appeared 25 years ago. Virtually all of the issues Rachel Carson explored are in some stage of correction and an aware public is now on guard. A philosophy has emerged which includes utilization of a variety of tools in controlling pests rather than chemicals alone.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group

18. DISTRIBUTION STATEMENT RELEASE TO THE PUBLIC	19. SECURITY CLASS *(This Report)* UNCLASSIFIED	21. NO. OF PAGES 16
	20. SECURITY CLASS *(This page)* UNCLASSIFIED	22. PRICE

EPA Form 2220-1 (Rev. 4-77) PREVIOUS EDITION IS OBSOLETE

NOTICE

This document has been reviewed in accordance with U.S. Environmental Protection Agency policy and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

MANY ROADS AND OTHER WORLDS

Gino Marco, Robert Hollingworth, William Durham

Rachel Carson concluded Silent Spring with a chapter titled, "The Other Road," proposing a biological, essentially non-chemical approach to pest control. In summarizing this "Revisit," an attempt is made to examine her ideas with the perspective of nearly 25 years past experience to ask whether she was right, where the issues she states now stand, and what type of use and safety controls have evolved. Our book is likely to fail badly in the eyes of those who love Rachel Carson's language and imagery. The preceding chapters were written by practicing scientists, schooled in the need to be conservative in their interpretation of data, to write directly and to avoid speaking to the emotions.

The control of pests has been desired throughout the more than 10,000 years of farming, since pests have always competed for food. As early as 3,000 years ago, sulfur was used and, as time progressed, copper, lead and arsenic compounds were added. These compounds have had some human health effects, but the environmental consequences were unrecognized. Thus, simple, generally inorganic chemicals have been used for a long time. However, it was the introduction of synthetic organic chemicals as a new technology, especially the organochlorine pesticides

typified by DDT, that led to the issues expressed in Silent Spring.

In the 19th Century, it required 90% of the population in the United States to supply the needed food and fiber, compared to about 4% today. The increased use of technology which has allowed this efficiency in modern agriculture has included much use of chemicals. Tillage practices and farm labor could be reduced, while continually increasing farm production. These are the visible benefits of pesticide use. The persistent organochlorine insecticides were the main thrust of Carson's concerns about overuse and misuse. These and some other pesticides led to the abuse of the environment, hazards for wildlife and possibly even to toxic effects in man. These are the hidden costs of pesticide use. Silent Spring led society to evaluate the new technologies in terms of risk versus benefits rather than on the basis of benefits alone. In fact, many people feel that there is now a predominant concern about risk. When there is a measurable but very small presence of a chemical in the environment or food supply, perspective on its significance is often lost. As the public's concern grew from apathy to advocacy, Congress responded by a series of amendments to already existing laws, with safety in mind, mandating the protection of public health and the environment. This emphasis was catalyzed by Silent Spring and continues till the present.

In order to establish risk and define safe usage, the amount of pesticide present in a sample must be assessed. In Carson's day, analyses were done mainly using intensity of color to measure the amounts present. These procedures requiring large samples were time-consuming and not highly sensitive (e.g., state-of-the-art was in the range of parts per million), and they were generally not selective (i.e., they measured more than one chemical, but often interpreted this as only one). Even the later introduction of more sensitive and specific analytical methods, such as gas chromatography, did not lead to unequivocal results: that is, DDT values from the 1960's may be unreliable because of confusion with other organochlorine compounds such as polychlorobiphenyls (PCBs). Silent Spring served to encourage funding for improved analytical procedures and instrumentation. These concerted efforts, along with added regulations, have brought about an improved scientific base of information upon which safety decisions are reached. However, while lower and lower levels can now be detected, the true significance of these small amounts is often quite uncertain. All chemicals can be toxic at a sufficiently high level. The real risk occurs when the chemical exceeds its toxic level, which may be considerably above the lower limit for detectability in the environment.

Since Silent Spring, analytical chemistry has greatly increased the sensitivity in the detection of residues, in some cases (i.e., dioxin) by at least one million times, and acceptable analyses usually measure only the particular chemical desired. Although amounts present can be determined with high accuracy, evaluating risk also requires the evaluation of the toxicity of the chemical. This is a complex process with large uncertainties, and cannot provide similarly precise answers. Thus, scientists and regulators in trying to relate the possibilities of low levels of exposure to their possible toxic effects in man or other living systems are forced to make intuitive value judgements that lead to controversies, even among themselves. The public often overestimates the abilities of science to predict adverse effects. Risk is assumed avoidable and an abundant food supply taken for granted. While understanding and observing more in our society, we still have many unknowns. All to often, to an uninformed and confused public, seeing, and even just hearing, is fearing.

One of the assumptions that Silent Spring challenged was that our environment, especially water, had an almost infinite capacity to cleanse itself. In fact, we have since learned to our surprise that highly persistent compounds can exist for many

years in the environment, be transported globally, and accumulate in living organisms far from their site of application. The residues in wildlife of the older organochlorine pesticides (e.g., DDT, aldrin, dieldrin, etc.) have declined slowly but significantly since Silent Spring, because most are now limited in use or even banned. As one of the more important legacies, Silent Spring served to stimulate an organized approach to studying chemical effects on our ecosystems. This has greatly increased our knowledge of the fate of chemicals in the environment, yet new problems still arise. With well water becoming a prominent water source, concerns over groundwater contamination are becoming prevalent. While the application of pesticides to broad expanses of farmland can contribute chemicals to ground water under a limited range of conditions, such contamination seems more likely to come from hazardous waste disposal sites. Rachel Carson was prescient in alluding to such problems from chemical dumps. Also, the "old" persistent, fat soluble, non-leaching pesticides have been replaced with chemicals that are relatively non-persistent but more mobile in the soil. What often happens with advancing technology is that the solution of one problem can generate another set of different and often more complex problems.

Birds were the prime example used by Rachel Carson to illustrate and speculate upon the effects of pesticides on wildlife. The removal of DDT and related type pesticides from use has decreased many undesired effects in birds, although some of the newer more toxic insecticides still have caused local problems in bird populations. Increased demands for ecological information on chemicals is constantly enhancing our understanding of such undesired effects. Modern strategies of pesticide development, including tests for toxicity in birds, are leading to products that minimize damage to bird populations. In addition, the public's desire to protect the environment has resulted in the modification and extension of regulations to protect wildlife.

Rachel Carson's concerns about the health effects of pesticides have led to a carefully managed approach in pesticide development covering chemical design, controlled formulation and use, and proper disposal; all with human safety in mind. With the use of pesticides for suicide and a sometime casual or erroneous reporting of death, the extent of accidental poisonings is difficult to assess even in the U.S. Also, the incidence of non-lethal injury to those using pesticides and possible long-term chronic effects are less well defined and are more controversial. Regulations to control worker exposure are contin-

ually revised and broadened; however, there are still unavoidable weaknesses in this safety net. The long delayed response and need to use animal models of debatable significance in toxicity testings has made cancer risk measurement for humans difficult, and in many cases, inexact. Thus, there is still confusion about the carcinogenic potential of many pesticides and some older compounds have not been evaluated with methods deemed satisfactory by today's standards. In fact, Miss Carson's view that "man alone of all life forms, can create cancer producing substances" was seriously misleading since nature does indeed produce such substances, e.g., in the "bracken that once lifted high its proud lacework" and in the aflatoxins of Aspergillus mold just to name two. This is not an argument to ignore the additional burden of man-made compounds, but simply to point out that chemical poisons are already prevalent in nature.

Industry has responded to the public's concerns by developing less persistent pesticides that are non-bioaccumulating, used at low rates and have potential for use in Integrated Pest Management programs; that is, approaches that use many control

methods and not chemicals alone. The government responded with extended new legislation to control all aspects of pesticide uses, including health and environment, continuing this process to the present. Environmentalists responded by organizing advocacy groups. As a consequence, our society has not been allowed to forget or ignore the abuses as described in Silent Spring. These problems are now less prevalent in the United States and, where seen, corrective action is generally quickly initiated once problem areas are defined. It is also becoming apparent that the broad utility of biological controls alone is still in the future. The often proposed combination of biological and chemical controls will require many more trained technologists than are presently being produced.

The diverse opinions and opposing views between manufacturer/user and environmentalist are clearly seen in the chapters of this book. In fact, the same information can be viewed in different ways. Our present high agricultural productivity is dependent on use of monoculture techniques with great control of nutrients and pests, limited options for crop rotations, increasing biological resistance to existing pesticides, and the genetic selection of plants for high yields - sometimes ignoring resistance to pests and disease. The manufacturer/user interprets these situations as 1) a need for better-growing high yield plants which can lead to increased insect infestation

requiring more control, 2) a requirement for new, safe pesticides with different mechanisms of actions, 3) a use of fertilization to produce lush plants, although possibly leading to more weed problems, and 4) a chance to increase the competitiveness and profitablity of our agriculture in providing cheap and plentiful food of the highest quality. The environmentalist looks upon this as 1) a broader use of more pest-susceptible plants in inherently unstable monocultures leading to more crop losses, 2) a newer class of pesticides introduced into the environment with unpredictable side effects, 3) a degradation of the soil integrity by over-fertilization and over-production at a time of agricultural surpluses, and 4) a high density farming strategy with heavy agrochemical inputs resulting in more hidden costs and delaying the application of biological and other non-chemical controls. The manufacturer/user looks upon the described situations as opportunities to increase food and fiber for an ever-growing population. The environmentalist looks on the same picture as an increased assault on nature and man, with the worry that Rachel Carsons' warning will be forgotten.

While Rachel Carson wrote predominantly about the developed countries, concentrating on the United States, there exist the other worlds of the underdeveloped nations. In developed countries having control of disease and an adequate food supply, the evaluation of the hazards of pesticides results primarily in concerns about long-term, low-level residues and environmental effects. In the underdeveloped nations, the first priority is survival in the face of a tropical climate that maintains pest and disease pressures year round, where illiteracy and extreme poverty are present, and where few technically trained people are available. These countries do not have the money to purchase or the resources to manufacture the "newer" improved pesticides and must use the "older", cheaper, pesticides with their familiar problems. Many of the issues discussed in Silent Spring could now apply to these other societies. There exist poor storage conditions, overuse, misuse, uncontrolled disposal and excessive worker exposure. Developed countries should take notice since food is exported from these nations, and there is the potential for global transportation of residues from overused pesticides. In expressing such concerns to the underdeveloped nations, corrective action has often occurred, but overreaction and fear have also been noted which can be counter-productive.

So where are we some twenty five years after Silent Spring? With fewer farmers and less labor expended, yet more mouths to feed, there seems no likelihood of completely eliminating chemical controls in the near future. The introduction of biological controls is far from a panacea and requires a more sophisticated approach requiring many trained technologists. The newer biotechnology approaches of gene manipulation to produce, for example, pest-resisting plants appears to be a slow and costly process. The promise is great, but the eventual impact unknowable. Meanwhile, nature does not stand still in its ability to adapt to any challenge. We can expect pests to adapt to effective biological controls just as they have to chemicals. Futhermore, it is not certain in the long run, that biological methods of pest control will be safer than chemicals to mankind and our environment. The other underdeveloped societies will most likely be brought into the domain of modern agriculture. They will leave behind the problem chemicals and train their people in the proper use of pesticides. And, Silent Spring will still be around to refresh their memories.

Was Rachel Carson right? In many respects, yes. In her time, the environment was being relentlessly assaulted for a hopeful total control by man. Nature was not as self-cleansing as we believed. Many of her projections about environmental toxicity, human health effects, water contamination, and waste site problems have occurred. Was she wrong? In fewer respects, yes. Nature generates its share of carcinogens and other poisons, not just man. Nature and man use chemicals to their advantage. Biological controls alone have been able to replace chemicals only in a few specific cases (e.g. the screw worm and cotton cushion scale) (1). However, biological-chemical combinations, as in Integrated Pest Management (IPM), have met with some success mainly in controlling insects. Other pesticide use areas (i.e diseases, weeds and nematodes) are being investigated (2). Present approaches to IPM are to optimize the use, not eliminate chemicals. Rachel Carson has set in motion a philosophy to use all tools in controlling pests, not to rely exclusively on chemicals. Man's lifespan is still increasing. Society has responded, and birds still sing.

Virtually all the issues Rachel Carson explored are in some stage of correction and an aware public is now on guard. The future has many roads, not one. Some of these roads are as

unexplored and unknown, as that for the organic pesticides when they were first introduced. The options now are many, more complex and, certainly, more costly. The other worlds still have the issues of Silent Spring to contend with, since it will always be in the background. Hopefully, the experience of the developed world will help such less fortunate societies bypass the old problems.

Literature Cited

(1) Graham, F., Jr., In The Dragon Hunters; E. P. Dutton Inc., 2 Park Ave., New York, 10016, 1984

(2) Adkisson, P.L., Bulletin of EAS, Fall 1986.

BC-115